

2nd International Conference on Information Technology and Quantitative Management,
ITQM 2014

Identifying Citation Classics in Fuzzy Decision Making Field using the Concept of H-Classics

M.J. Cobo^{a,*}, M.A. Martínez^b, M. Gutiérrez-Salcedo^c, M. Herrera^d, E. Herrera-Viedma^e

^aDept. Computer Science, University of Cádiz, Spain

^bDept. Social Work, International University of La Rioja (UNIR), Spain

^cDept. Management and Marketing, University of Jaén, Spain

^dDept. Sociology III, Distance Learning University of Spain (UNED), Spain

^eDept. Computer Science and A.I. (CITIC-UGR), University of Granada, Spain

Abstract

Citation classics identify those highly cited papers which are an important reference point in a research field. Identifying citation classics in a research field is one of the main approaches used to conduct a systematic evaluation of research performance. Highly cited articles are interesting due to the potential association between high citation counts and high quality research.

The aim of this study is to identify and analyze the most frequently cited papers published into the Fuzzy Decision Making research field, using the H-Classics approach which is based in the well-known H-index. The Fuzzy Decision Making is represented by 70 highly citations classics which were published from 1981 to 2010. Furthermore, authors, affiliations, journals and the concept covered by those 70 highly cited documents are analyzed.

We identify three countries that have contributed substantially to development of the Fuzzy Decision Making research field: Spain, Peoples Republic of China and USA. Regarding the journals, *Fuzzy Sets and Systems*, *European Journal of Operation Research*, *IEEE Transactions on Fuzzy Systems* and *International Journal of Intelligent Systems* are the ones where the citations classics have been mainly published. Finally, the concepts covered by those citations classics are related with techniques and tools used in Fuzzy Sets theory and Fuzzy Decision Making research field, and terms related with Decision making theory and its developments.

© 2014 The Authors. Published by Elsevier B.V. Open access under [CC BY-NC-ND license](https://creativecommons.org/licenses/by-nc-nd/4.0/).

Selection and peer-review under responsibility of the Organizing Committee of ITQM 2014.

Keywords: Citation classics; bibliometric measures; h-index; fuzzy decision making.

1. Introduction

Systematic evaluation of research performance has been emphasised for optimising research allocation, reorientating research support, rationalising research organisations, restricting research in particular fields, or augmenting research productivity¹. Identifying citation classics in the field is one of the key methodologies to achieve these goals.

* Corresponding author.

E-mail address: manueljesus.cobo@uca.es

Citation classics is a bibliometric concept introduced by Eugene Garfield² to designate those highly cited papers of a scientific discipline. It is currently defined as a highly cited publication as identified by the Science Citation Index, the Social Sciences Citation Index, or the Arts and Humanities Citation Index³. Citation classics help to discover potentially important information for the development of a discipline and also to understand the past, present and future of its scientific structure. According to⁴ an analysis of the citation classics of a research field, i) allows to recognize the major advances in the discipline and to discover the hot topics to inspire other works in the area, ii) gives a historical perspective on the scientific progress of the speciality and iii) identifies also the main intellectual markers of the research field, such as journals, researchers, countries, universities, institutions or research groups.

Although the citation classics is a concept well understood by the scientific community, there is still no standard way to identify them⁴. There are two main approaches: setting citation thresholds⁵ or choosing a number of papers in the top of the list of highly cited papers². Although both methods have been widely used by the research community^{6,7,8,9,10,11,12}, they have as main drawback the identification of the specific threshold which will change depending on the analyzed field.

To overcome this drawback, recently M.A. Martínez et. al. proposed a method⁴ to identify the citation classics based on the robust bibliometric measure H-index^{13,14}.

The main aim of this contribution is to identify the papers (articles and reviews) considered as classic in the Fuzzy Decision Making research field. Furthermore, the universities or institutions, authors, countries and journals which more have contributed to those citation classics are analyzed. Moreover, the thematics covered by those highly cited papers are shown.

The Fuzzy Decision Making^{15,16} research field born from the synergy of the Decision Making and Fuzzy Sets research fields. Decision Making is a common task carried out by humans each day. Its goal is to find a best decision from among some possible options¹⁶. A lot of real world decision making processes take place in an environment in which the aims, the constraints and the consequences of possible actions are not precisely known. Thus, Fuzzy Sets theory^{17,18} is a common tool used to deal with imprecision and vagueness problem, and also to represent the concept in a natural way through linguistic terms. In this sense, to deal with imprecision in the Decision Making research field, fuzzy set theory are employed.

This contribution is organized as follows: Section 2 describes the method used to identify the citation classics and the data used in this analysis. Section 3 shows the obtained results. Finally, some conclusions are drawn in Section 4.

2. Methodology and corpus

Bibliometrics is a science based on the citation analysis of the research documents and used mainly to evaluate research performance^{4,3}. A basic assumption of citation analysis is that the more often a paper becomes cited the greater its influence on the field¹⁹. So, a higher citation rate indicates a higher quality¹. In this sense, citation classics identify those highly cited papers which are an important reference point in a research field. Awareness of the citation classics in a field is advantageous to identify the authors who have published significant findings on particular research topics as well as the short- or long-term impact of their work from the literary perspective¹.

As aforementioned, the classic methods to identify the citation classics consist on to set a specific threshold (number of documents or citations count)^{2,5}. The documents which exceed this threshold will be considered to belong to the set of citation classics. The selection of the threshold will depend on the research field to analyze, but there is no rigorous scientific argument to select it. In order to overcome this drawback a new approach based on the H-index is proposed in⁴, called H-Classics.

Formally, the H-Classics is defined as⁴: “*H-Classics of a research area A could be defined as the H-core of A that is composed of the H highly cited papers with more than H citations received.*”

The identification process of the H-Classics of the Fuzzy Decision Making research field consists on the the following steps⁴:

- Selection of the bibliographic database to retrieve the scientific production and citations. ISI Web of Science (ISIWoS) was selected as bibliographic database due to it contains the most reliable and accurate citations data.
- Set the research area under study by defining a query to retrieve the articles and reviews of whole research field. Usually, the research area is delimited using the most important journal of the field, and filter those documents

by a set of terms or keywords⁴. In others case, the journals are complemented with those documents containing a set of keywords. In this contribution, we select the most important journals (JCR 2012) related to the field of Fuzzy Decision Making research field. Since, those journals publish documents related with other topics, a set of keywords was used in order to filter the papers to the research field under study. The query used to retrieve the corpus is: *SO=("FUZZY SETS AND SYSTEMS" OR "IEEE TRANSACTIONS ON FUZZY SYSTEMS" OR "INTERNATIONAL JOURNAL OF UNCERTAINTY FUZZINESS AND KNOWLEDGE BASED SYSTEMS" OR "JOURNAL OF INTELLIGENT FUZZY SYSTEMS" OR "INTERNATIONAL JOURNAL OF FUZZY SYSTEMS" OR "IRANIAN JOURNAL OF FUZZY SYSTEMS" OR "FUZZY OPTIMIZATION AND DECISION MAKING" OR "FUZZY LOGIC AND APPLICATIONS" OR "ROUGH SETS FUZZY SETS DATA MINING AND GRANULAR COMPUTING" OR "INFORMATION FUSION" OR "INFORMATION SCIENCE" OR "INTERNATIONAL JOURNAL OF INFORMATION TECHNOLOGY & DECISION MAKING" OR "IEEE TRANSACTIONS ON SYSTEMS MAN AND CYBERNETICS PART A-SYSTEMS AND HUMANS" OR "IEEE TRANSACTIONS ON SYSTEMS MAN AND CYBERNETICS PART B-CYBERNETICS" OR "INTERNATIONAL JOURNAL OF GENERAL SYSTEMS" OR "APPLIED SOFT COMPUTING" OR "SOFT COMPUTING" OR "KNOWLEDGE-BASED SYSTEMS" OR "CONTROL AND CYBERNETICS" OR "COMPUTERS & MATHEMATICS WITH APPLICATIONS" OR "EUROPEAN JOURNAL OF OPERATIONAL RESEARCH" OR "EXPERT SYSTEMS WITH APPLICATIONS" OR "INTERNATIONAL JOURNAL OF APPROXIMATE REASONING" OR "INTERNATIONAL JOURNAL OF INTELLIGENT SYSTEMS") AND TS=("fuzzy decision making" OR "fuzzy group decision making" OR "fuzzy preference*" OR "aggregation operator*" OR "fuzzy AHP*" OR "fuzzy analytic hierarchy process" OR "fuzzy majority" OR "fuzzy quantifier*") NOT TS="FUZZY QUERYING", which returns an amount of 1146 documents (articles and reviews).*

- Calculate the H-index of the research field. Using the ISIWoS capabilities, the list of returned documents was ordered by citations count in order to compute the H-index of the Fuzzy Decision Making research area, obtaining a H-index of 70.
- Recover the H highly cited papers that are included in the H-Core. Then, we retrieve the 70 documents belonging to the H-Core in order to analyze the affiliation, publications data, and the topics covered by those documents. The list of full references is shown in Appendix A.

We should point out that the retrieved raw data was imported into the science mapping analysis open source software SciMAT^{20,21} in order to build a knowledge base and perform a preprocessing step. In particular, a de-duplication step was carried out over authors, affiliations and keywords in order to merge into one entity those items that represent the same author, affiliations, or concept, respectively. Finally, Wordle¹ was used to build the cloud tags.

3. Results and quantitative analysis

In this section, an quantitative analysis of the H-Classics of the Fuzzy Decision Making research field is done. Four aspects have been analyzed: i) longitudinal, ii) affiliations (authors and universities), iii) journals, and iv) most used terms or keywords.

The research conducted by the Fuzzy Decision Making community has a H-index of 70, thus, we identify as citation classics the top 70 highly cited papers. The first classics appears in 1981, in it Zadeh L.A described the fuzzy quantifiers in the context of natural language¹⁵. During the period 2000-2010 there are a great increase in the number of citations classics. In fact, 2000 is the year when more citation classics were published. The last citation classics were published in 2010. In Figure 1, the distribution of citation classics per year is shown.

The quantitative measures of authors and their affiliations are shown in Tables 1–3, where only those authors, universities or countries with more than two citation classics are shown.

Taking into account Tables 1–3, we should remark that Spain, its institutions and researchers are ranked in the first positions. In fact, the Spanish University of Granada have almost three times more citation classics that the second institutions in the rank (Iona College). Regarding the authors (Table 1), the Professors E. Herrera-Viedma (Spain),

¹ <http://www.wordle.net/>

F. Herrera (Spain), F. Chiclana (England), and Z.S. Xu (Peoples Republic of China) are the authors that more have contributed to de development of the Fuzzy Decision Making research field. Regarding the institutions or universities (Table 2), with the Spanish university of Granada, four of them stand out: Iona College (USA), De Montfort University (England), Southeast Univerity (Peoples Republic of China) and University of Jaén (Spain). Finally, we should remark that Peoples Republic of China and USA have published a high number of citations classics as can be shown in Table 3. They together with Spain are the three countries that more have contributed to the field of Fuzzy Decision Making.

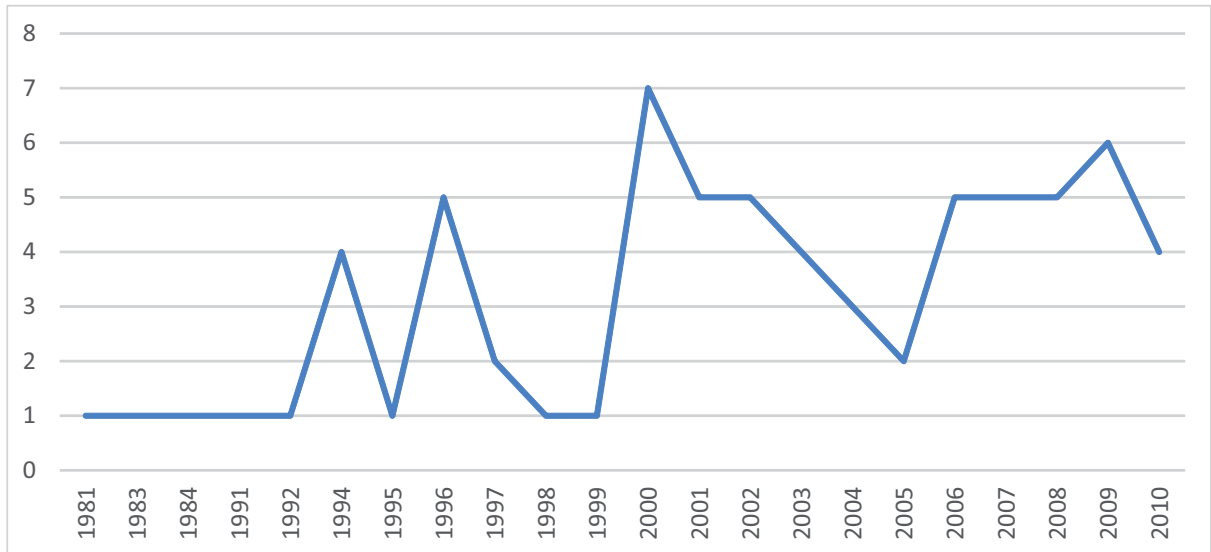


Fig. 1. Distribution of classics per year

Table 1. Authors with more than two classics.

Authors	#documents
Herrera-Viedma, E	16
Herrera, F	15
Chiclana, F	10
Xu, ZS	10
Yager, RR	6
Martínez, L	5
Alonso, S	4
Cheng, CH	3
Kacprzyk, J	3
Wei, GW	3
Chang, DY	2
Da, QL	2
Fedrizzi, M	2
Grabisch, M	2
Mata, F	2
Mikhailov, L	2
Nurmi, H	2
Szmidt, E	2

In Table 4 the journals that have published more than two citation classics are shown. We should remark that the journal *Fuzzy Sets and Systems* is the most important journal in the field of Fuzzy Decision Making, due to 20 of the highly cited papers have been published in that journal. Furthermore, along *Fuzzy Sets and Systems*, the journals i) *European Journal of Operation Research*, ii) *IEEE Transactions on Fuzzy Systems*, and iii) *International Journal of Intelligent Systems*, with 13, 9 and 8 citation classics respectively, have significantly contributed to the development

Table 2. Universities or institutions with more than tree classics.

Institution	#documents
University of Granada	17
Iona College	6
De Montfort University	5
Southeast University	5
University of Jaén	5
Chongqing University Arts & Science	3
Beijing Materials College	2
National Yunlin University Science & Technology	2
Polish Academy Science	2
Thomson-CSF, Central Research Laboratory	2
Tsing Hua University	2
University of Illes Balears	2
University of Trento	2
University of Turku	2

Table 3. Countries with more than three classics.

Country	#documents
Spain	20
Peoples R China	18
USA	10
England	8
Taiwan	7
Belgium	2
Finland	2
France	2
India	2
Italy	2
Poland	2
Turkey	2

of Fuzzy Decision Making research field. In fact, *Fuzzy Sets and Systems* and *IEEE Transactions on Fuzzy Systems* are the most important journal of the whole Fuzzy Sets research field.

Finally, in order to discover the thematic covered by the 70 citation classics of the Fuzzy Decision Making research field, a cloud tags (Figure 2) was built using the keywords provided by the authors and those provided by the bibliographic database (*ISI Keywords Plus*). The set of keywords were de-duplicated using SciMAT²¹, in order to join those terms that represent the same concept. In Figure 2 the size of the terms are proportional to its frequency.

Table 4. Documents published by each journal.

Journal	#documents
FUZZY SETS AND SYSTEMS	20
EUROPEAN JOURNAL OF OPERATIONAL RESEARCH	13
IEEE TRANSACTIONS ON FUZZY SYSTEMS	9
INTERNATIONAL JOURNAL OF INTELLIGENT SYSTEMS	8
APPLIED SOFT COMPUTING	3
EXPERT SYSTEMS WITH APPLICATIONS	3
IEEE TRANSACTIONS ON SYSTEMS MAN AND CYBERNETICS PART A-SYSTEMS AND HUMANS	3
INTERNATIONAL JOURNAL OF APPROXIMATE REASONING	3
INTERNATIONAL JOURNAL OF GENERAL SYSTEMS	2
COMPUTERS & MATHEMATICS WITH APPLICATIONS	1
CONTROL AND CYBERNETICS	1
IEEE TRANSACTIONS ON SYSTEMS MAN AND CYBERNETICS PART B-CYBERNETICS	1
INFORMATION FUSION	1
INTERNATIONAL JOURNAL OF UNCERTAINTY FUZZINESS AND KNOWLEDGE-BASED SYSTEMS	1
KNOWLEDGE-BASED SYSTEMS	1

Analyzing Figure 2 we could identify terms related with techniques used in Fuzzy Decision Making research field, and terms related with its development.

5. Ponce F, Lozano A. The most cited works in parkinson's disease. *Movement Disorders* 2011;**26**(3):380–90.
6. Fejoo JF, Limeres J, Fernández-Varela M, Ramos I, Diz P. The 100 most cited articles in dentistry. *Clinical oral investigations* 2013::1–8.
7. Ibrahim GM, Carter Snead O, Rutka JT, Lozano AM. The most cited works in epilepsy: Trends in the "citation classics". *Epilepsia* 2012; **53**(5):765–70.
8. Ponce FA, Lozano AM. Highly cited works in neurosurgery. part ii: the citation classics: A review. *Journal of neurosurgery* 2010;**112**(2):233–46.
9. Ponce FA, Lozano AM. The most cited works in parkinson's disease. *Movement Disorders* 2011;**26**(3):380–90.
10. Stack S. Citation classics in suicide and life threatening behavior: A research note. *Suicide and Life-Threatening Behavior* 2012;**42**(6):628–39.
11. Stack S. Citation classics in deviant behavior: A research note. *Deviant Behavior* 2013;**34**(2):85–96.
12. Tam WW, Wong EL, Wong FC, Hui DS. Citation classics: Top 50 cited articles in respiratory system. *Respirology* 2013;**18**(1):71–81.
13. Alonso S, Cabrerizo FJ, Herrera-Viedma E, Herrera F. h-index: A review focused in its variants, computation and standardization for different scientific fields. *Journal of Informetrics* 2009;**3**(4):273–89.
14. Hirsch J. An index to quantify an individuals scientific research out-put. *Proceedings of the National Academy of Sciences* 2005;**102**:16569–72.
15. Bellman RE, Zadeh LA. Decision-making in a fuzzy environment. *Management Science* 1970;**17**(4):141–64.
16. Herrera F, Herrera-Viedma E, Verdegay J. A sequential selection process in group decision making with a linguistic assessment approach. *Information Sciences* 1995;**85**(4):223–39.
17. Zadeh L. Fuzzy sets. *Information and Control* 1965;**8**(3):338–53.
18. Zadeh L. Is there a need for fuzzy logic? *Information Sciences* 2008;**178**(13):2751–79.
19. Garfield E. *Citation Indexing: Its Theory and Application in Science, Technology, and Humanities*. John Wiley & Sons, Inc. NY; 1979.
20. Cobo MJ, López-Herrera AG, Herrera-Viedma E, Herrera F. Science mapping software tools: Review, analysis and cooperative study among tools. *Journal of the American Society for Information Science and Technology* 2011;**62**(7):1382–402.
21. Cobo MJ, López-Herrera AG, Herrera-Viedma E, Herrera F. Scimat: A new science mapping analysis software tool. *Journal of the American Society for Information Science and Technology* 2012;**63**(8):1609–30.

Appendix A. H-Core research documents list

Table A.5: H-Core: list with the 70 highly cited documents of Fuzzy Decision Making research field

Rank	Paper	#Citations
1	ZADEH LA. A Computational Approach To Fuzzy Quantifiers In Natural Languages. <i>Computers & Mathematics With Applications</i> 9:1 149-184 (1983).	735
2	CHANG DY. Applications Of The Extent Analysis Method On Fuzzy Ahp. <i>European Journal Of Operational Research</i> 95:3 649-655 (1996).	517
3	HERRERA F, MARTINEZ L. A 2-tuple Fuzzy Linguistic Representation Model For Computing With Words. <i>Ieee Transactions On Fuzzy Systems</i> 8:6 746-752 (2000).	484
4	HERRERA F, HERRERA-VIDEAMA E. Linguistic Decision Analysis: Steps For Solving Decision Problems Under Linguistic Information. <i>Fuzzy Sets And Systems</i> 115:1 67-82 (2000).	458
5	VAIDYA OS, KUMAR S. Analytic Hierarchy Process: An Overview Of Applications. <i>European Journal Of Operational Research</i> 169:1 1-29 (2006).	320
6	CHICLANA F, HERRERA F, HERRERA-VIDEAMA E. Integrating Three Representation Models In Fuzzy Multipurpose Decision Making Based On Fuzzy Preference Relations. <i>Fuzzy Sets And Systems</i> 97:1 33-48 (1998).	318
7	HERRERA F, HERRERA-VIDEAMA E, VERDEGAY JL. A Model Of Consensus In Group Decision Making Under Linguistic Assessments. <i>Fuzzy Sets And Systems</i> 78:1 73-87 (1996).	314
8	XU ZS, DA QL. An Overview Of Operators For Aggregating Information. <i>International Journal Of Intelligent Systems</i> 18:9 953-969 (2003).	263
9	TANINO T. Fuzzy Preference Orderings In Group Decision-making. <i>Fuzzy Sets And Systems</i> 12:2 117-131 (1984).	262
10	HONG DH, CHOI CH. Multicriteria Fuzzy Decision-making Problems Based On Vague Set Theory. <i>Fuzzy Sets And Systems</i> 114:1 103-113 (2000).	259
11	GRABISCH M. The Application Of Fuzzy Integrals In Multicriteria Decision Making. <i>European Journal Of Operational Research</i> 89:3 445-456 (1996).	247
12	YAGER RR, RYBALOV A. Uninorm Aggregation Operators. <i>Fuzzy Sets And Systems</i> 80:1 111-120 (1996).	237

Continued on next page

Table A.5 – Continued from previous page

Rank	Paper	#Citations
13	CHEN SM, TAN JM. Handling Multicriteria Fuzzy Decision-making Problems Based On Vague Set-theory. <i>Fuzzy Sets And Systems</i> 67:2 163-172 (1994).	234
14	HERRERA F, HERRERA-VIEDMA E, MARTINEZ L. A Fusion Approach For Managing Multi-granularity Linguistic Term Sets In Decision Making. <i>Fuzzy Sets And Systems</i> 114:1 43-58 (2000).	231
15	HERRERA-VIEDMA E, HERRERA F, CHICLANA F, LUQUE M. Some Issues On Consistency Of Fuzzy Preference Relations. <i>European Journal Of Operational Research</i> 154:1 98-109 (2004).	222
16	BORDOGNA G, FEDRIZZI M, PASI G. A Linguistic Modeling Of Consensus In Group Decision Making Based On Owa Operators. <i>Ieee Transactions On Systems Man And Cybernetics Part A-systems And Humans</i> 27:1 126-132 (1997).	219
17	XU ZS, YAGER RR. Some Geometric Aggregation Operators Based On Intuitionistic Fuzzy Sets. <i>International Journal Of General Systems</i> 35:4 417-433 (2006).	217
18	CHICLANA F, HERRERA F, HERRERA-VIEDMA E. Integrating Multiplicative Preference Relations In A Multipurpose Decision-making Model Based On Fuzzy Preference Relations. <i>Fuzzy Sets And Systems</i> 122:2 277-291 (2001).	212
19	XU ZS. Intuitionistic Fuzzy Aggregation Operators. <i>Ieee Transactions On Fuzzy Systems</i> 15:6 1179-1187 (2007).	204
20	GRABISCH M. Fuzzy Integral In Multicriteria Decision-making. <i>Fuzzy Sets And Systems</i> 69:3 279-298 (1995).	195
21	XU ZS. An Overview Of Methods For Determining Owa Weights. <i>International Journal Of Intelligent Systems</i> 20:8 843-865 (2005).	194
22	HERRERA F, HERRERA-VIEDMA E. Aggregation Operators For Linguistic Weighted Information. <i>Ieee Transactions On Systems Man And Cybernetics Part A-systems And Humans</i> 27:5 646-656 (1997).	185
23	KAHRAMAN C, ERTAY T, BUYUKOZKAN, G. A Fuzzy Optimization Model For Qfd Planning Process Using Analytic Network Approach. <i>European Journal Of Operational Research</i> 171:2 390-411 (2006).	181
24	KACPRZYK J, FEDRIZZI M, NURMI H. Group Decision-making And Consensus Under Fuzzy Preferences And Fuzzy Majority. <i>Fuzzy Sets And Systems</i> 49:1 21-31 (1992).	181
25	HERRERA F, HERRERA-VIEDMA E, CHICLANA F. Multiperson Decision-making Based On Multiplicative Preference Relations. <i>European Journal Of Operational Research</i> 129:2 372-385 (2001).	178
26	HERRERA-VIEDMA E, HERRERA F, CHICLANA F. A Consensus Model For Multiperson Decision Making With Different Preference Structures. <i>Ieee Transactions On Systems Man And Cybernetics Part A-systems And Humans</i> 32:3 394-402 (2002).	177
27	HERRERA-VIEDMA E, MARTINEZ L, MATA F, CHICLANA F. A Consensus Support System Model For Group Decision-making Problems With Multigranular Linguistic Preference Relations. <i>Ieee Transactions On Fuzzy Systems</i> 13:5 644-658 (2005).	162
28	CHENG CH, LIN Y. Evaluating The Best Main Battle Tank Using Fuzzy Decision Theory With Linguistic Criteria Evaluation. <i>European Journal Of Operational Research</i> 142:1 174-186 (2002).	150
29	CHEN CT. A Fuzzy Approach To Select The Location Of The Distribution Center. <i>Fuzzy Sets And Systems</i> 118:1 65-73 (2001).	149
30	XU ZS, DA QL. The Uncertain Owa Operator. <i>International Journal Of Intelligent Systems</i> 17:6 569-575 (2002).	138
31	NURMI H. Approaches To Collective Decision-making With Fuzzy Preference Relations. <i>Fuzzy Sets And Systems</i> 6:3 249-259 (1981).	137
32	ZHU KJ, JING Y, CHANG, DY. A Discussion On Extent Analysis Method And Applications Of Fuzzy Ahp. <i>European Journal Of Operational Research</i> 116:2 450-456 (1999).	133
33	WEI GW. Some Induced Geometric Aggregation Operators With Intuitionistic Fuzzy Information And Their Application To Group Decision Making. <i>Applied Soft Computing</i> 10:2 423-431 (2010).	128
34	XU ZS, YAGER RR. Dynamic Intuitionistic Fuzzy Multi-attribute Decision Making. <i>International Journal Of Approximate Reasoning</i> 48:1 246-262 (2008).	127
35	LEUNG LC, CAO D. On Consistency And Ranking Of Alternatives In Fuzzy Ahp. <i>European Journal Of Operational Research</i> 124:1 102-113 (2000).	127

Continued on next page

Table A.5 – Continued from previous page

Rank	Paper	#Citations
36	TRIANAPHYLLOU E, LIN CT. Development And Evaluation Of Five Fuzzy Multiattribute Decision-making Methods. <i>International Journal Of Approximate Reasoning</i> 14:4 281-310 (1996).	127
37	HERRERA-VIEDMA E, ALONSO S, CHICLANA F, HERRERA F. A Consensus Model For Group Decision Making With Incomplete Fuzzy Preference Relations. <i>Ieee Transactions On Fuzzy Systems</i> 15:5 863-877 (2007).	124
38	MIKHAILOV L. Deriving Priorities From Fuzzy Pairwise Comparison Judgements. <i>Fuzzy Sets And Systems</i> 134:3 365-385 (2003).	124
39	HERRERA-VIEDMA E, CHICLANA F, HERRERA F, ALONSO S. Group Decision-making Model With Incomplete Fuzzy Preference Relations Based On Additive Consistency. <i>Ieee Transactions On Systems Man And Cybernetics Part B-cybernetics</i> 37:1 176-189 (2007).	119
40	YAGER RR. Induced Aggregation Operators. <i>Fuzzy Sets And Systems</i> 137:1 59-69 (2003).	113
41	HERRERA F, HERRERA-VIEDMA E, MARTINEZ L. A Fuzzy Linguistic Methodology To Deal With Unbalanced Linguistic Term Sets. <i>Ieee Transactions On Fuzzy Systems</i> 16:2 354-370 (2008).	110
42	HO W. Integrated Analytic Hierarchy Process And Its Applications - A Literature Review. <i>European Journal Of Operational Research</i> 186:1 211-228 (2008).	108
43	XU ZS. Induced Uncertain Linguistic Owa Operators Applied To Group Decision Making. <i>Information Fusion</i> 7:2 231-238 (2006).	107
44	MARICHAL JL. An Axiomatic Approach Of The Discrete Choquet Integral As A Tool To Aggregate Interacting Criteria. <i>Ieee Transactions On Fuzzy Systems</i> 8:6 800-807 (2000).	105
45	BORAN FE, GENÇ S, KURT M, AKAY D. A Multi-criteria Intuitionistic Fuzzy Group Decision Making For Supplier Selection With Topsis Method. <i>Expert Systems With Applications</i> 36:8 11363-11368 (2009).	101
46	ZHAO H, XU ZS, NI MF, LIU SS. Generalized Aggregation Operators For Intuitionistic Fuzzy Sets. <i>International Journal Of Intelligent Systems</i> 25:1 1-30 (2010).	97
47	SENGUPTA A, PAL TK. On Comparing Interval Numbers. <i>European Journal Of Operational Research</i> 127:1 28-43 (2000).	94
48	YAGER RR. Aggregation Operators And Fuzzy-systems Modeling. <i>Fuzzy Sets And Systems</i> 67:2 129-145 (1994).	91
49	CHICLANA F, HERRERA-VIEDMA E, HERRERA F, ALONSO S. Some Induced Ordered Weighted Averaging Operators And Their Use For Solving Group Decision-making Problems Based On Fuzzy Preference Relations. <i>European Journal Of Operational Research</i> 182:1 383-399 (2007).	90
50	XU ZS, DA WL. The Ordered Weighted Geometric Averaging Operators. <i>International Journal Of Intelligent Systems</i> 17:7 709-716 (2002).	90
51	CALVO T, DE BAETS B, FODOR J. The Functional Equations Of Frank And Alsina For Uninorms And Nullnorms. <i>Fuzzy Sets And Systems</i> 120:3 385-394 (2001).	86
52	VOJTAS P. Fuzzy Logic Programming. <i>Fuzzy Sets And Systems</i> 124:3 361-370 (2001).	85
53	YAGER RR, FILEV DP. Parameterized And-like And Or-like Owa Operators. <i>International Journal Of General Systems</i> 22:3 297-316 (1994).	85
54	MATA F, MARTINEZ L, HERRERA-VIEDMA E. An Adaptive Consensus Support Model For Group Decision-making Problems In A Multigranular Fuzzy Linguistic Context. <i>Ieee Transactions On Fuzzy Systems</i> 17:2 279-290 (2009).	84
55	WANG YM, LUO Y, HUA Z. On The Extent Analysis Method For Fuzzy Ahp And Its Applications. <i>European Journal Of Operational Research</i> 186:2 735-747 (2008).	84
56	MAS M, MONSERRAT M, TORRENS J, TRILLAS E. A Survey On Fuzzy Implication Functions. <i>Ieee Transactions On Fuzzy Systems</i> 15:6 1107-1121 (2007).	82
57	WANG JH, HAO JY. A New Version Of 2-tuple. Fuzzy Linguistic, Representation Model For Computing With Words. <i>Ieee Transactions On Fuzzy Systems</i> 14:3 435-445 (2006).	80
58	MIKHAILOV L, TSVETINOV P. Evaluation Of Services Using A Fuzzy Analytic Hierarchy Process. <i>Applied Soft Computing</i> 5:1 23-33 (2004).	80
59	SZMIDT E, KACPRZYK J. Using Intuitionistic Fuzzy Sets In Group Decision Making. <i>Control And Cybernetics</i> 31:4 1037-1053 (2002).	80
60	WEI GW. Uncertain Linguistic Hybrid Geometric Mean Operator And Its Application To Group Decision Making Under Uncertain Linguistic Environment. <i>International Journal Of Uncertainty Fuzziness And Knowledge-based Systems</i> 17:2 251-267 (2009).	79

Continued on next page

Table A.5 – Continued from previous page

Rank	Paper	#Citations
61	LEE AHI, CHEN WC, CHANG CJ. A Fuzzy Ahp And Bsc Approach For Evaluating Performance Of It Department In The Manufacturing Industry In Taiwan. <i>Expert Systems With Applications</i> 34:1 96-107 (2008).	77
62	XU ZS. Goal Programming Models For Obtaining The Priority Vector Of Incomplete Fuzzy Preference Relation. <i>International Journal Of Approximate Reasoning</i> 36:3 261-270 (2004).	77
63	MON DL, CHENG CH, LIN JC. Evaluating Weapon System Using Fuzzy Analytic Hierarchy Process-based On Entropy Weight. <i>Fuzzy Sets And Systems</i> 62:2 127-134 (1994).	77
64	OVCHINNIKOV S. Similarity Relations, Fuzzy Partitions, And Fuzzy Orderings. <i>Fuzzy Sets And Systems</i> 40:1 107-126 (1991).	77
65	SZMIDT E, KACPRZYK J. A Consensus-reaching Process Under Intuitionistic Fuzzy Preference Relations. <i>International Journal Of Intelligent Systems</i> 18:7 837-852 (2003).	75
66	TAN CQ, CHEN XH. Intuitionistic Fuzzy Choquet Integral Operator For Multi-criteria Decision Making. <i>Expert Systems With Applications</i> 37:1 149-157 (2010).	74
67	WEI GW. Gra Method For Multiple Attribute Decision Making With Incomplete Weight Information In Intuitionistic Fuzzy Setting. <i>Knowledge-based Systems</i> 23:3 243-247 (2010).	72
68	MERIGO JM, CASANOVAS M. Induced Aggregation Operators In Decision Making With The Dempster-shafer Belief Structure. <i>International Journal Of Intelligent Systems</i> 24:8 934-954 (2009).	72
69	ALONSO S, CABRERIZO FJ, CHICLANA F, HERRERA F, HERRERA-VIEDMA E. Group Decision Making With Incomplete Fuzzy Linguistic Preference Relations. <i>International Journal Of Intelligent Systems</i> 24:2 201-222 (2009).	70
70	WANG JW, CHENG CH, KUN-CHENG H. Fuzzy Hierarchical Topsis For Supplier Selection. <i>Applied Soft Computing</i> 9:1 377-386 (2009).	70